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In order to continue enjoying our site, we ask that you confirm your identity as a human. Thank you very much for your cooperation. ,the free encyclopedia that anyone can edit.117,185 active editors 7,001,875 articles in EnglishThe English-language Wikipedia thanks its contributors for creating more than seven million articles! Learn how you can take part in the encyclopedia's continued improvement.Members of the victorious Blondie crewThe Boat Race 2018 took place on 24March. Held annually, The Boat Race is a side-by-side rowing race between crews from the universities of Oxford and Cambridge along a 4.2-mile (6.8km) tidal stretch of the River Thames in south-west London, England. For the third time in the history of the event, the men's, the women's and both reserves' races were all held on the Tideway on the same day. The women's race saw Cambridge lead from the start, eventually winning by a considerable margin to take the overall record to 4330 in their favour. In the women's reserve race, Cambridge's Blondie (crew pictured) defeated Oxford's Osiris by nine lengths. The men's reserve race was won by Cambridge's Goldie, who defeated Oxford's Isis by a margin of four lengths. The men's race was the final event of the day and completed a whitewash as Cambridge won, taking the overall record to 8380 in their favour. The races were watched by around 250,000 spectators live, and broadcast around the world. (Fullarticle...)Recently featured: Radar, Gun Laying, Mk.I and Mk.IIAndrea NavageroNosy KombaArchiveBy emailMore featured articlesAboutKitty Marion... that Kitty Marion (pictured) was force-fed over 200 times during a hunger strike?... that the North Korean destroyer Choe Hyon is the largest ship constructed for the Korean People's Navy?... that after the release of High and Low, director Akira Kurosawa received telephone calls imitating his film that threatened to kidnap his daughter?... that May Bradford Shockley is why Silicon Valley is where it is?... that the conservation of a goat might endanger the survival of Aquilegia paui?... that Joy Laking predicted in a school writing assignment that within ten years she would be making a living as an artist?... that the Taiwanese restaurant chain Formosa Chang drew inspiration from McDonald's for its non-greasy atmosphere and corporate practices?... that Haridas Mitra had his death sentence commuted after the intervention of Mahatma Gandhi?... that "Steve's Lava Chicken" recently became the shortest song to enter the UK Top 40?ArchiveStart a new articleNominate an articleNgg wa Thiong'oKenyan writer and activist Ngg wa Thiong'o (pictured) dies at the age of 87.In sumo, nosato Daiki is promoted to yokozuna.In association football, Liverpool win the Premier League title.In motor racing, lex Palou wins the Indianapolis 500.In basketball, the EuroLeague concludes with Fenerbahe winning the Final Four Playoff.Ongoing: Gaza warM23 campaignRussian invasion of UkrainetimelineSudanese civil wartimelineRecent deaths: Harrison Ruffin TylerPhil RobertsonMary K. GaillardPeter DavidAlan YentobGerry ConnollyNominate an articleMay 31: Dragon Boat Festival in China and Taiwan (2025); World No Tobacco DayBessarion455 Petronius Maximus, the ruler of the Western Roman Empire, was stoned to death by a mob as he fled Rome ahead of the arrival of a Vandal force that sacked the city.1223 Mongol invasion of Kievan Rus': Mongol forces defeated a Kievan Rus' army at the Battle of the Kalka River in present-day Ukraine.1468 Cardinal Bessarion (pictured) announced his donation of 746 Greek and Latin codices to the Republic of Venice, forming the Biblioteca Marciana.1935 A magnitude-7.7 earthquake struck Balochistan in British India, now part of Pakistan, killing between 30,000 and 60,000 people.2013 An extremely large, powerful, and erratic tornado struck Central Oklahoma, killing eight people and injuring more than 150 others.Albertino Mussato (d.1329)Joseph Grimaldi (d.1837)Dina Boluarte (b.1962)Mbaye Diagne (d.1994)More anniversaries: May 30May 31June 1ArchiveBy emailList of days of the yearAboutCucumis metuliferus, the African horned cucumber, is an annual vine in the cucumber and melon family, Cucurbitaceae. Its fruit has horn-like spines, hence the name "horned melon". The ripe fruit has orange skin and lime-green, jelly-like flesh. It is native to Southern Africa, where it is a traditional food. Along with the gemsbok cucumber and the citron melon, it is one of the few sources of water during the dry season in the Kalahari Desert. This photograph, which was focus-stacked from 25 separate images, shows two C.metuliferus fruits, one whole and the other in cross-section.Photograph credit: Ivar LeidusRecently featured: Ignace TonenAustralian white ibisHell Gate BridgeArchiveMore featured picturesCommunity portal The central hub for editors, with resources, links, tasks, and announcements.Village pump Forum for discussions about Wikipedia itself, including policies and technical issues.Site news Sources of news about Wikipedia and the broader Wikimedia movement.Teahouse Ask basic questions about using or editing Wikipedia.Help desk Ask questions about using or editing Wikipedia.Reference desk Ask research questions about encyclopedic topics.Content portals A unique way to navigate the encyclopedia.Wikipedia is written by volunteer editors and hosted by the Wikimedia Foundation, a non-profit organization that also hosts a range of other volunteer projects: CommonsFree media repository MediaWikiWiki software development Meta-WikiWikimedia project coordination WikibooksFree textbooks and manuals WikidataFree knowledge base WikinewsFree-content news WikiquoteCollection of quotations WikisourceFree-content library WikispeciesDirectory of species WikiversityFree learning tools WikivoyageFree travel guide WiktionaryDictionary and thesaurusThis Wikipedia is written in English. Many other Wikipedias are available; some of the largest are listed below. 1,000,000+ articles DeutschEspaolFranaisItalianoNederlandsPolskiPortugusSvenskaTing Vit 250,000+ articles Bahasa IndonesiaBahasa MelayuBn-lm-gCataletinaDanskEestiEsperantoEuskaraMagyarNorsk bokmlRomnSimple EnglishSlovenina SrpskiSrpskohrvatskiSuomiTrkeOzbekcha 50,000+ articles AsturianuAzrbaycancaBosanskiFryskGaeilgeGalegoHrvatskiKurdLatvieuLietuviNorsk nynorskShqipSlovenina Retrieved from " 2This article is about the year 455. For other uses, see 455 (disambiguation).This article needs additional citations for verification. Please help improve this article by adding citations to reliable sources. Unsourced material may be challenged and removed.Find sources:"455"news newspapers books scholar JSTOR (April 2019) (Learn how and when to remove this message)Calendar yearYearsMillennium1stmillenniumCenturies4thcentury5thcentury 6thcenturyDecades430s440s450s 460s470sYears452453454455 456457458vte455 by topicLeadersPolitical entitiesState leadersReligious leadersCategoriesBirthsDeathsDisestablishmentsvte455 in various calendarsGregorian calendar455CDLVAb urbe condita1208Assyrian calendar5205Balinese saka calendar376377Bengali calendar139 138Berber calendar1405Buddhist calendar999Burmese calendar183Byzantine calendar59635964Chinese calendar (WoodHorse)3152 or 2945to (WoodGoat)3153 or 2946Coptic calendar171172Discordian calendar1621Ethiopian calendar447448Hebrew calendar42154216Hindu calendars- Vikram Samvat511512- Shaka Samvat376377- Kali Yuga35553556Holocene calendar10455Iranian calendar167 BP 166 BPIslamic calendar172 BH 171 BHJavanese calendar340341Julian calendar455CDLVKorean calendar2788Minguo calendar1457 before ROC1457Nanakshahi calendar1013Seleucid era766/767 AGThai solar calendar997998Tibetan calendar(male Wood-Horse)581 or 200 or 572to(female Wood-Goat)582 or 201 or 571King Genseric sacks Rome (455)Year 455 (CDLV) was a common year starting on Saturday of the Julian calendar. At the time, it was known as the Year of the Consulship of Valentinianus and Anthemius (or, less frequently, year 1208 Ab urbe condita). The denomination 455 for this year has been used since the early medieval period, when the Anno Domini calendar era became the prevalent method in Europe for naming years.March 16 Emperor Valentinian III, age 35, is assassinated by two Hunnic retainers of the late Flavius Aetius, while training with the bow on the Campus Martius (Rome), ending the Theodosian dynasty. His primicerius sacri cubiculi, Heraclius, is also murdered.March 17 Petronius Maximus, former domesticus ("elite bodyguard") of Aetius, becomes (with support of the Roman Senate) emperor of the Western Roman Empire. He secures the throne by bribing officials of the imperial palace. Maximus consolidates his power by a forced marriage with Licinia Eudoxia, widow of Valentinian III.Maximus appoints Avitus, most trusted general, to the rank of magister militum and sends him on an embassy to Toulouse, to gain the support of the Visigoths. He elevates his son Palladius to Caesar and has him marry Eudocia, eldest daughter of Valentinian III.May 31 Maximus is stoned to death by an angry mob while fleeing Rome. A widespread panic occurs when many citizens hear the news that the Vandals are plundering the Italian mainland.June 2 Sack of Rome: King Genseric leads the Vandals into Rome, after he has promised Pope Leo I not to burn and plunder the city. Genseric sacks the city for a period of two weeks. Eudoxia and her daughters, Eudocia and Placidia, are taken hostage. The loot is sent to the harbour of Ostia and loaded into ships, from whence the Vandals depart and return to Carthage.July 9 Avitus is proclaimed Roman emperor at Toulouse, and later recognised by the Gallic chiefs in Viernum (near Arles).September 21 Avitus enters Rome with a Gallic army. He restores the imperial authority in Noricum (modern Austria) and leaves a Gothic force under Remistus, Visigoth general (magister militum), at Ravenna.The Ostrogoths conquer Pannonia and Dalmatia.Battle of Aylesford: Prince Vortimer rebels against the pro-Anglo-Saxon policies of his father, Vortigern. He is defeated in the battle at Aylesford (Kent). Hengist and his son Oisc become king of Kent. Horsa and Catigern, brother of Vortimer, are killed. The Britons withdraw to London (according to the Anglo-Saxon Chronicle).Skandagupta succeeds Kumaragupta I as ruler of the Gupta Empire (India). During his reign he crushes the Hun invasion; however, the expense of the wars drains the empire's resources and contributes to its decline.Gaero becomes king of the Korean kingdom of Baekje.[1]Earliest recorded date at Chichen Itza on the Yucatn Peninsula (Mexico) (approximate date).Barter economy replaces organized trade as Romans and other citizens desert their towns for the countryside, where they will be less vulnerable to barbarian raids (approximate date).The city of Vindobona (Vienna) is struck by an epidemic that spreads through the Roman provinces. The disease is probably streptococcus or a form of scarlet fever with streptococcus pneumoniae (approximate date).Rusticus, archbishop of Lyon (approximate date)Wang Baoming, empress of the Southern Qi (d. 512)March 16Valentinian III, emperor of the Western Roman Empire (b. 419)Heraclius, Roman courtier (primicerius sacri cubiculi)May 31 Petronius Maximus, emperor of the Western Roman EmpireBiyu of Baekje, king of Baekje[1]Catigern, prince and son of Vortigern (approximate date)Horsa, leader of the Anglo-Saxons (approximate date)Kumaragupta I, ruler of the Gupta Empire (India)Niall Noigiallach, High King of Ireland (approximate date)Palladius, son of Petronius Maximus (approximate date)Prosper of Aquitaine, disciple and Christian writer (approximate date)^ a b "List of Rulers of Korea". www.metmuseum.org. Retrieved April 20, 2019.Retrieved from " 3One hundred years, from 301 to 400Millennia1stmillenniumCenturies3rdcentury4thcentury5thcenturyTimelines3rdcentury4thcentury5thcenturyState leaders3rdcentury4thcentury5thcenturyDecades300s310s320s330s340s350s360s370s380s390sCategories:Births Deaths Establishments DisestablishmentsvteEastern Hemisphere at the beginning of the 4th century CE.Eastern Hemisphere at the end of the 4th century CE.The 4th century was the time period from 301 CE (represented by the Roman numerals CCCI) to 400 CE (CD) in accordance with the Julian calendar. In the West, the early part of the century was shaped by Constantine the Great, who became the first Roman emperor to adopt Christianity. Gaining sole reign of the empire, he is also noted for re-establishing a single imperial capital, choosing the site of ancient Byzantium in 330 (over the current capitals, which had effectively been changed by Diocletian's reforms to Milan in the West, and Nicomedeia in the East) to build the city soon called Nova Roma (New Rome); it was later renamed Constantinople in his honor.The last emperor to control both the eastern and western halves of the empire was Theodosius I. As the century progressed after his death, it became increasingly apparent that the empire had changed in many ways since the time of Augustus. The two-emperor system originally established by Diocletian in the previous century fell into regular practice, and the east continued to grow in importance as a centre of trade and imperial power, while Rome itself diminished greatly in importance due to its location far from potential trouble spots, like Central Europe and the East. Late in the century Christianity became the official state religion, and the empire's old pagan culture began to disappear.[citation needed] General prosperity was felt throughout this period, but recurring invasions by Germanic tribes plagued the empire from 376[1][2] CE onward. These early invasions marked the beginning of the end for the Western Roman Empire.In China, the Jin dynasty, which had united the nation prior in 280, began rapidly facing trouble by the start of the century due to political infighting, which led to the insurrections of the northern barbarian tribes (starting the Sixteen Kingdoms period), which quickly overwhelmed the empire, forcing the Jin court to retreat and entrench itself in the south past the Yangtze river, starting what is known as the Eastern Jin dynasty around 317. Towards the end of the century, Emperor of the Former Qin, Fu Jin, united the north under his banner, and planned to conquer the Jin dynasty in the south, so as to finally reunite the land, but was decisively defeated at the Battle of Fei River in 383, causing massive unrest and civil war in his empire, thereby leading to the fall of the Former Qin, and the continued existence of the Eastern Jin dynasty.According to archaeologists, sufficient archaeological evidence correlates of state-level societies coalesced in the 4th century to show the existence in Korea of the Three Kingdoms (300/400668 CE) of Baekje, Goguryeo, and Silla.Historians of the Roman Empire refer to the "Long Fourth Century" to the period spanning the fourth century proper but starting earlier with the accession of the Emperor Diocletian in 284 and ending later with the death of Honorius in 423 or of Theodosius II in 450.[3]See also: Christianity in the 4th centuryGregory the Illuminator mosaic, converted Armenia from Zoroastrianism to ChristianityContemporary bronze head of Constantine I (r. 306337 AD)Early 4th century Former audience hall now known as the Basilica, Trier, Germany, is built.Early 4th century The Gupta Empire is established.301: Armenia first to adopt Christianity as state religion.304439: The Sixteen Kingdoms in China begins.306337: Constantine the Great, ends persecution of Christians in the Roman Empire (see also Constantinian shift) and Constantinople becomes new seat of government (New Rome).Tikal had a population of about 100,000 when it was conquered by Teotihuacan, less than a fourth of its peak population[4]320: Butuan Boat One, the oldest known Balangay, a multi-purpose ship native to the Philippines is built.325328: The Kingdom of Aksum adopts Christianity.325: Constantine the Great calls the First Council of Nicaea to pacify Christianity in the grip of the Arian controversy.335380: Samudragupta expands the Gupta Empire.337: Constantine the Great is baptized a Christian on his death bed.350: About this time the Kingdom of Aksum conquers the Kingdom of Kush.350400: At some time during this period, the Huns began to attack the Sassanid Empire.[2]350: The Kutai Martadipura kingdom in eastern Borneo produced the earliest known stone inscriptions in Indonesia known as the Mulavarman inscription written in the Sanskrit language using Pallava scripture.[5]Mid-4th century Dish, from Mildenhall, England, is made. It is now kept at the British Museum, London.Mid-4th century Wang Xizhi makes a portion of a letter from the Feng Ju album. Six Dynasties period. It is now kept at National Palace Museum, Taipei, Taiwan, Republic of China.365: An earthquake with a magnitude of at least eight strikes the Eastern Mediterranean. The following tsunami causes widespread destruction in Crete, Greece, Libya, Egypt, Cyprus, and Sicily.376: Visigoths appear on the Danube and are allowed entry into the Roman Empire in their flight from the Huns.378: Battle of Adrianople: Roman army is defeated by the Visigoth cavalry. Emperor Valens is killed.378395: Theodosius I, Roman emperor, bans pagan worship, Christianity is made the official religion of the Empire.378: Siyaj K'ak' conquers Waka on (January 8), Tikal (January 16) and Uaxactun.Wall painting of the Council of Constantinople (381) in the Stavropoleos monastery, Romania381: First Council of Constantinople reaffirms the Christian doctrine of the Trinity by adding to the creed of Nicaea.383: Battle of Fei River in China.395: The Battle of Canhe Slope occurs.395: Roman emperor Theodosius I dies, causing the Roman Empire to split permanently.Late 4th century: Cubiculum of Leonis, Catacomb of Commodilla, near Rome, is made.Late 4th century: Atrium added in the Old St. Peter's Basilica, Rome.For a more comprehensive list, see Timeline of historic inventions 4th century.The Stirrup was invented in China, no later than 322.[6][1]Kama Sutra, dated between c.400 BC to c. 300 AD.[7][8]Iron pillar of Delhi, India is the world's first Iron Pillar.[citation needed]Trigonometric functions: The trigonometric functions sine and versine originated in Indian astronomy.[9]Codex Sinaiticus and the Codex Vaticanus Graecus 1209, are the earliest Christian bibles.[10][11]Book of Steps, Syriac religious discourses.[citation needed]^ a b "The invention and influences of stirrup". 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Retrieved 16 March 2013.Retrieved from " 4The following pages link to 4th century External tools(link counttransclusion countsorted list) See help page for transcluding these entriesShowing 50 items.View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)List of decades, centuries, and millennia (links | edit)Religion in pre-Islamic Arabia (links | edit)Rosetta Stone (links | edit)20th century (links | edit)15th century (links | edit)16th century (links | edit)17th century (links | edit)18th century (links | edit)14th century (links | edit)1st century (links | edit)13th century (links | edit)397 (links | edit)12th century (links | edit)11th century (links | edit)7th century (links | edit)10th century (links | edit)9th century (links | edit)8th century (links | edit)6th century (links | edit)5th century (links | edit)3rd century (links | edit)2nd century (links | edit)405 (links | edit)4th century BC (links | edit)432 (links | edit)200s (decade) (links | edit)300s (decade) (links | edit)1st century BC (links | edit)2nd century BC (links | edit)3rd century BC (links | edit)5th century BC (links | edit)6th century BC (links | edit)400s (decade) (links | edit)310s (links | edit)320s (links | edit)321 (links | edit)21st century BC (links | edit)11th century BC (links | edit)286 (links | edit)476 (links | edit)385 (links | edit)7th century BC (links | edit)410 (links | edit)325 (links | edit)380s (links | edit)381 (links | edit)470s (links | edit)430s (links | edit)430 (links | edit)510s (links | edit)View (previous 50 | next 50) (20 | 50 | 100 | 250 | 500)Retrieved from " WhatLinksHere/4th_century"Its time to prepare for your A-level chemistry exam. Dont be daunted by the volume of material you need to go through or anything you may not know 100% yet, thats where we at A-level Chemistry come in with loads of revision notes of your coursework no matter if its AQA, OCR or EdExcel. Weve got revision notes that will help you familiarize yourself with the major themes and topics that tend to come up in the exams so youll feel prepared and confident before you enter the exam hall. To make the most of revision notes, whether youre making your own or using ours, keep reading to learn top tips that will facilitate deep learning. Lets get started: When revising, make sure youve allocated enough time to go through all your coursework at least four times. Without proper planning, you could end up skimming or skipping sections, losing sleep and stressing yourself out. Create a timetable that will give you sufficient time to dedicate to each topic and stick to it. Effective retention and recall are based on your ability to create strong associations. If you rely on only one way to recall information, if you hit a mental block youre unable to retrieve it. By adding things like colour, symbols, diagrams, keywords, patterns or doodles, you create much stronger connections in your brain and multiple routes to the same information. A word of caution though - dont fall into the procrastination trap of making your revision notes the prettiest in the world. Do whats necessary to remember, then move on. While on the topic of procrastination, dont give in to distractions or urges to suddenly tidy your room and pair all of your socks. Procrastination often comes from a deeper place. Are you avoiding revision because you feel overwhelmed? Are you afraid of performing badly in your exam? Is it because youre intimidated by how much you still need to learn? Are you bored? Address where your urge to procrastinate is coming from and then get back to the books. Keep in mind that your brain is like a sponge and that it takes time to process information. Limit your revision sessions to between 40 to 60 minutes and then stretch your legs and take a break for 10 minutes. Its also important to do more than just read as youll soon lose focus. Include other activities like note-taking or mind mapping to keep you engaged. Whether you use revision guides like ours or choose to make your own, science has proven that one of the best things to do for learning is to sleep on it. Sleep helps to process information and transfer it from the short-term to the long-term memory, which is why planning is so important to A-level chemistry success. Were not going to wish you good luck with your revision, because lucks got nothing to do with it, thorough preparation does, and were confident that between our revision notes and your brains, youll do just great! Lets get started. Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Oxidation and Reduction Oxidation-Reduction Reactions The term oxidation was originally used to describe reactions in which an element combines with oxygen. Example: The reaction between magnesium metal and oxygen to form magnesium oxide involves the oxidation of magnesium. The term reduction comes from the Latin stem meaning "to lead back." Anything that that leads back to magnesium metal therefore involves reduction. The reaction between magnesium oxide and carbon at 2000C to form magnesium metal and carbon monoxide is an example of the reduction of magnesium oxide to magnesium metal. After electrons were discovered, chemists became convinced that oxidation-reduction reactions involved the transfer of electrons from one atom to another. From this perspective, the reaction between magnesium and oxygen is written as follows. 2 Mg + O2 2 [Mg2+][O2-] In the course of this reaction, each magnesium atom loses two electrons to form an Mg2+ ion. Mg Mg2+ + 2 e- And, each O2 molecule gains four electrons to form a pair of O2- ions. O2 + 4 e- 2 O2- Because electrons are neither created nor destroyed in a chemical reaction, oxidation and reduction are linked. It is impossible to have one without the other, as shown in the figure below. The Role of Oxidation Numbers in Oxidation-Reduction Reactions Chemists eventually extended the idea of oxidation and reduction to reactions that do not formally involve the transfer of electrons. Consider the following reaction. CO(g) + H2O(g) CO2(g) + H2(g) As can be seen in the figure below, the total number of electrons in the valence shell of each atom remains constant in this reaction. What changes in this reaction is the oxidation state of these atoms. The oxidation state of carbon increases from +2 to +4, while the oxidation state of the hydrogen decreases from +1 to 0. Oxidation and reduction are therefore best defined as follows. Oxidation occurs when the oxidation number of an atom becomes larger. Reduction occurs when the oxidation number of an atom becomes smaller. Oxidation Numbers Versus the True Charge on Ions The terms ionic and covalent describe the extremes of a continuum of bonding. There is some covalent character in even the most ionic compounds and vice versa. It is useful to think about the compounds of the main group metals as if they contained positive and negative ions. The chemistry of magnesium oxide, for example, is easy to understand if we assume that MgO contains Mg2+ and O2- ions. But no compounds are 100% ionic. There is experimental evidence, for example, that the true charge on the magnesium and oxygen atoms in MgO is +1.5 and -1.5. Oxidation states provide a compromise between a powerful model of oxidation-reduction reactions based on the assumption that these compounds contain ions and our knowledge that the true charge on the ions in these compounds is not as large as this model predicts. By definition, the oxidation state of an atom is the charge that atom would carry if the compound were purely ionic. For the active metals in Groups IA and IIA, the difference between the oxidation state of the metal atom and the charge on this atom is small enough to be ignored. The main group metals in Groups IIIA and IVA, however, form compounds that have a significant amount of covalent character. It is misleading, for example, to assume that aluminum bromide contains Al3+ and Br- ions. It actually exists as Al2Br6 molecules. This problem becomes even more severe when we turn to the chemistry of the transition metals. MnO, for example, is ionic enough to be considered a salt that contains Mn2+ and O2- ions. Mn2O7, on the other hand, is a covalent compound that boils at room temperature. It is therefore more useful to think about this compound as if it contained manganese in a +7 oxidation state, not Mn7+ ions. Oxidizing Agents and Reducing Agents Let's consider the role that each element plays in the reaction in which a particular element gains or loses electrons.. When magnesium reacts with oxygen, the magnesium atoms donate electrons to O2 molecules and thereby reduce the oxygen. Magnesium therefore acts as a reducing agent in this reaction. 2 Mg + O2 2 MgO reducing agent The O2 molecules, on the other hand, gain electrons from magnesium atoms and thereby oxidize the magnesium. Oxygen is therefore an oxidizing agent. 2 Mg + O2 2 MgO oxidizing agent Oxidizing and reducing agents therefore can be defined as follows. Oxidizing agents gain electrons. Reducing agents lose electrons. The table below identifies the reducing agent and the oxidizing agent for some of the reactions discussed in this web page. One trend is immediately obvious: The main group metals act as reducing agents in all of their chemical reactions. Typical Reactions of Main Group Metals Reaction Reducing Agent Oxidizing Agent 2 Na + Cl2 2 NaCl Na Cl2 2 K + H2 2 KH K H2 4 Li + O2 2 Li2O Li O2 2 Na + O2 Na2O2 Na O2 2 Na + 2 H2O 2 Na+ + 2 OH- + H2 Na H2O 2 K + 2 NH3 2 K+ + 2 NH2- + H2 K NH3 2 Mg + O2 2 MgO Mg O2 3 Mg + N2 Mg3N2 Mg N2 Ca + 2 H2O Ca2+ + 2 OH- + H2 Ca H2O 2 Al + 3 Br2 Al2Br6 Al Br2 Mg + 2 H+ Mg2++ H2 Mg H+ Mg + H2O MgO + H2 Mg H2O Conjugate Oxidizing Agent/Reducing Agent Pairs Metals act as reducing agents in their chemical reactions. When copper is heated over a flame, for example, the surface slowly turns black as the copper metal reduces oxygen in the atmosphere to form copper(II) oxide. If we turn off the flame, and blow H2 gas over the hot metal surface, the black CuO that formed on the surface of the metal is slowly converted back to copper metal. In the course of this reaction, CuO is reduced to copper metal. Thus, H2 is the reducing agent in this reaction, and CuO acts as an oxidizing agent. An important feature of oxidation-reduction reactions can be recognized by examining what happens to the copper in this pair of reactions. The first reaction converts copper metal into CuO, thereby transforming a reducing agent (Cu) into an oxidizing agent (CuO). The second reaction converts an oxidizing agent (CuO) into a reducing agent (Cu). Every reducing agent is therefore linked, or coupled, to a conjugate oxidizing agent, and vice versa. Every time a reducing agent loses electrons, it forms an oxidizing agent that could gain electrons if the reaction were reversed. Conversely, every time an oxidizing agent gains electrons, it forms a reducing agent that could lose electrons if the reaction went in the opposite direction. The idea that oxidizing agents and reducing agents are linked, or coupled, is why they are called conjugate oxidizing agents and reducing agents. Conjugate comes from the Latin stem meaning "to join together." It is therefore used to describe things that are linked or coupled, such as oxidizing agents and reducing agents. The main group metals are all reducing agents. They tend to be "strong" reducing agents. The active metals in Group IA, for example, give up electrons better than any other elements in the periodic table. The fact that an active metal such as sodium is a strong reducing agent should tell us something about the relative strength of the Na+ ion as an oxidizing agent. If sodium metal is relatively good at giving up electrons, Na+ ions must be unusually bad at picking up electrons. If Na is a strong reducing agent, the Na+ ion must be a weak oxidizing agent. Conversely, if O2 has such a high affinity for electrons that it is unusually good at accepting them from other elements, it should be able to hang onto these electrons once it picks them up. In other words, if O2 is a strong oxidizing agent, then the O2- ion must be a weak reducing agent. In general, the relationship between conjugate oxidizing and reducing agents can be described as follows. Every strong reducing agent (such as Na) has a weak conjugate oxidizing agent (such as the Na+ ion). Every strong oxidizing agent (such as O2) has a weak conjugate reducing agent (such as the O2- ion). The Relative Strength of Metals as Reducing Agents We can determine the relative strengths of a pair of metals as reducing agents by determining whether a reaction occurs when one of these metals is mixed with a salt of the other. Consider the relative strength of iron and aluminum, for example. Nothing happens when we mix powdered aluminum metal with iron(III) oxide. If we place this mixture in a crucible, however, and get the reaction started by applying a little heat, a vigorous reaction takes place to give aluminum oxide and molten iron metal. 2 Al(s) + Fe2O3(s) Al2O3(s) + 2 Fe(l) By assigning oxidation numbers, we can pick out the oxidation and reduction halves of the reaction. Aluminum is oxidized to Al2O3 in this reaction, which means that Fe2O3 must be the oxidizing agent. Conversely, Fe2O3 is reduced to iron metal, which means that aluminum must be the reducing agent. Because a reducing agent is always transformed into its conjugate oxidizing agent in an oxidation-reduction reaction, the products of this reaction include a new oxidizing agent (Al2O3) and a new reducing agent (Fe). Since the reaction proceeds in this direction, it seems reasonable to assume that the starting materials contain the stronger reducing agent and the stronger oxidizing agent. In other words, if aluminum reduces Fe2O3 to form Al2O3 and iron metal, aluminum must be a stronger reducing agent than iron. We can conclude from the fact that aluminum cannot reduce sodium chloride to form sodium metal that the starting materials in this reaction are the weaker oxidizing agent and the weaker reducing agent. We can test this hypothesis by asking: What happens when we try to run the reaction in the opposite direction? (Is sodium metal strong enough to reduce a salt of aluminum to aluminum metal?) When this reaction is run, we find that sodium metal can, in fact, reduce aluminum chloride to aluminum metal and sodium chloride when the reaction is run at temperatures hot enough to melt the reactants. 3 Na(l) + AlCl3(l) 3 NaCl(l) + Al(l) If sodium is strong enough to reduce Al3+ salts to aluminum metal and aluminum is strong enough to reduce Fe3+ salts to iron metal, the relative strengths of these reducing agents can be summarized as follows. Na > Al > Fe Practice Problem 4:Use the following equations to determine the relative strengths of sodium, magnesium, aluminum, and calcium metal as reducing agents. 2 Na + MgCl22 NaCl + Mg Al + MgBr2 Ca + MgI2 CaI2 + Mg Ca + 2 NaCl Click here to check your answer to Practice Problem 4 The oxidation number(O.N.) of an element represents the total number of electrons which have been removed (a positive oxidation state) or added (a negative oxidation state) to get the element into its present state. The term oxidation describes the loss of electrons by an element and an increase in oxidation state; the term reduction describes the gain of electrons and a decrease in oxidation state. Oxidation numbers for elements in compounds can be calculated using a simple set of rules, which are reproduced below in Table 5.3. Table 5.3 Rules for Assigning Oxidation Numbers 1. The oxidation number of an element in the free state is zero. 2. A monoatomic ion will have an oxidation number that is equal to its charge. 3. In most compounds, the oxidation number of hydrogen is+1 (exception: whenhydrogen is bonded to a metal, the oxidation number -1.) 4. Oxygen, within a compound, will generally have an oxidation number of 2 (exception: in peroxides, the oxidation number of oxygen is -1) 5. The oxidation numbersof combined elements from groups Iand II are +1 and +2, respectively. 6.The algebraic sum of oxidation numbersof all elements in a neutralcompound formula equals zero. 7.The algebraic sum of the oxidation numbersof all elements in a polyatomic ionis equal tothe charge of the ion In many chemical reactions, the oxidation number of elements change. Consider the synthesis reaction shown below. In the reactants, carbon and oxygen are both elements and their oxidation numbers are zero (Rule 1). In the product, oxygen will have an oxidation number of 2 (Rule 4), therefore, carbon in CO2 must have an oxidation number of +4 in order to balance the four negative charges on the oxygens. During this reaction, the oxidation number of carbon has changed from zero in the reactants to +4 in the products and the oxidation number of oxygen has changed from zero to 2. This is an example of a redox reaction; a chemical reaction in which the oxidation numbers of elements change on going from reactants to products. C (s) + O2 (g) CO2 (g) In a redox reaction, the element that loses electrons is said to be oxidized and will have an increase in its oxidation number. In the example above, the oxidation number of carbon increases from zero to +4; it has lost electrons and has been oxidized. The element that gains electrons in a redox reaction is said to be reduced and will have a decrease in its oxidation number. In the reaction above, the oxidation number of oxygen has decreased from zero to 2; it has gained electrons and has been reduced. An examination of the rules for assigning oxidation numbers reveals that there are many elements for which there are no specific rules, such as nitrogen, sulfur, and chlorine. These elements, as well as some others, can have variable oxidation numbers depending on the other atoms to which they are covalently bonded in a molecular compound. It is useful to analyze a few molecules in order to see the strategy to follow in assigning oxidation numbers to other atoms. Oxidation numbers for the atoms in a binary ionic compound are easy to assign because they are equal to the charge of the ion (rule 2). In CuCl2, the oxidation number of copperis+2, while the oxidation number of chlorine is1.This is because CuCl2 isan ionic compound that is actually composed of these ions. Assigning oxidation numbers for molecular compounds is trickier. The key is to remember rule 6: that the sum of all the oxidation numbers for any neutral species must be zero. Make sure to account for any subscripts which appear in the formula. As an example, consider the compound nitric acid,HNO3. According to rule 3, the oxidation number of hydrogen is+1. According to rule 4, the oxidation number of oxygen is2. There is no rule regarding nitrogen, but its oxidation number can be calculated as follows. 1(+1)+x+3(2)=0, where x is the oxidation number of nitrogen. Solving for x, we obtain x=+5 The oxidation number of the nitrogen atom inHNO3is+5 Examples\(\PageIndex{1}\) For each of the reactions given below, calculate the oxidation number of each of the elements in the reactants and the products and determine if the reaction involves oxidation-reduction. If it is a redox reaction, identify the elements that have been oxidized and reduced. Cu2S 2 Cu + S Reactants: Cu O.N.= +1 S O.N. = -2 Products: Cu O.N.= 0 S O.N.= 0 Element oxidized: sulfurElement Reduced: copper. This is a redoxreaction. CaCO3 CaO + CO2 Reactants: Ca O.N.= +2CO.N.= +4 O O.N.= -2 Products: Ca O.N.= +2CO.N.= +4 O O.N.= -2 Element oxidized: none.Element Reduced: none. This is non-redox reaction. Fe2O3 + 3 H2 2 Fe + 3 H2O Reactants: Fe O.N.=+3 O O.N.=-2H O.N.=0 Products: Fe O.N.=0O O.N.=-2HO.N.=+1 Element oxidized: hydrogen.Element Reduced: iron. This is a redox reaction AgNO3 + NaCl AgCl (s) + NaNO3 Reactants: Ag O.N.=+1 (cation)N O.N.=+5 (rule 6)O O.N.=-2 Na O.N.=+1 ClO.N.=-1 Ag O.N.=+1 (cation)N O.N.=+5 (rule 6)O O.N.=-2 Na O.N.=+1 ClO.N.=-1 Element oxidized: none.Element Reduced: none. This is a non-redox reaction Contributors When balancing redox reactions, the overall electronic charge must be balanced in addition to the usual molar ratios of the component reactants and products. This example problem illustrates how to use the half-reaction method to balance a redox reaction in a solution. Balance the following redox reaction in an acidic solution: Cu(s) + HNO3(aq) Cu2+(aq) + NO(g) Step 1: Identify what is being oxidized and what is being reduced. To identify which atoms are being reduced or oxidized, assign oxidation states to each atom of the reaction. For review: Cu(s): Cu = 0HNO3: H = +1, N = +5, O = -6Cu2+: Cu = +2NO(g): N = +2, O = -2 Cu went from oxidation state 0 to +2, losing two electrons. Copper is oxidized by this reaction.N went from oxidation state +5 to +2, gaining three electrons. Nitrogen is reduced by this reaction. Step 2: Break the reaction into two half-reactions: oxidation and reduction. Oxidation: Cu Cu2+ Reduction: HNO3 NO Step 3: Balance each half-reaction by both stoichiometry and electronic charge. This is accomplished by adding substances to the reaction. The only rule is that the only substances you can add must already be in the solution. These include water (H2O), H+ ions (in acidic solutions), OH- ions (in basic solutions) and electrons. Start with the oxidation half-reaction: The half-reaction is already balanced atomically. To balance electronically, two electrons must be added to the product side. Cu Cu2+ + 2 e- Now, balance the reduction reaction. This reaction requires more work. The first step is to balance all atoms except oxygen and hydrogen. HNO3 NO There is only one nitrogen atom on both sides, so nitrogen is already balanced. The second step is to balance the oxygen atoms. This is done by adding water to the side that needs more oxygen. In this case, the reactant side has three oxygens and the product side has only one oxygen. Add two water molecules to the product side. HNO3 NO + 2 H2O The third step is to balance the hydrogen atoms. This is accomplished by adding H+ ions to the side that needs more hydrogen. The reactant side has one hydrogen atom while the product side has four. Add 3 H+ ions to the reactant side. HNO3 + 3 H+ NO + 2 H2O The equation is balanced atomically, but not electrically. The final step is to balance the charge by adding electrons to the more positive side of the reaction. One the reactant side, the overall charge is +3, while the product side is neutral. To counteract the +3 charge, add three electrons to the reactant side. HNO3 + 3 H+ + 3 e- NO + 2 H2O Now the reduction half-equation is balanced. Step 4: Equalize the electron transfer. In redox reactions, the number of electrons gained must equal the number of electrons lost. To accomplish this, each reaction is multiplied by whole numbers to contain the same number of electrons. The oxidation half-reaction has two electrons while the reduction half-reaction has three electrons. The lowest common denominator between them is six electrons. Multiply the oxidation half-reaction by 3 and the reduction half-reaction by 2. 3 Cu 3 Cu2+ + 6 e-2 HNO3 + 6 H+ + 6 e- 2 NO + 4 H2O Step 5: Recombine the half-reactions. This is accomplished by adding the two reactions together. Once they are added, cancel out anything that appears on both sides of the reaction. 3 Cu 3 Cu2+ + 6 e-+ 2 HNO3 + 6 H+ + 6 e- 2 NO + 4 H2O 3 Cu + 2 HNO3 + 6H+ + 6 e- 3 Cu2+ + 2 NO + 4 H2O + 6 e- Both sides have six electrons that can be canceled. 3 Cu + 2 HNO3 + 6 H+ 3 Cu2+ + 2 NO + 4 H2O The complete redox reaction is now balanced. 3 Cu + 2 HNO3 + 6 H+ 3 Cu2+ + 2 NO + 4 H2O To summarize: Identify the oxidation and reduction components of the reaction.Separate the reaction into the oxidation half-reaction and reduction half-reaction.Balance each half-reaction both atomically and electronically.Equalize the electron transfer between oxidation and reduction half-equations.Recombine the half-reactions to form the complete redox reaction. Welcome to the ChemistryLibrary. This Living Library is a principal hub of the LibreTexts project, which is a multi-institutional collaborative venture to develop the next generation of open-access texts to improve postsecondary education at all levels of higher learning. The LibreTexts approach is highly collaborative where an Open Access textbook environment is under constant revision by students, faculty, and outside experts to supplant conventional paper-based books. Campus BookshelvesBookshelvesLearning Objects Home is shared under a not declared license and was authored, remixed, and/or curated by LibreTexts. A redox reaction is a chemical reaction in which the atoms change their oxidation numbers. Some atoms lose electrons and are oxidized a process known as oxidation. On the other hand, some atoms gain electrons and are reduced a process known as reduction. Therefore, both REDuction and OXidation take place simultaneously, hence the term redox. Redox reactions usually occur in one of two environments: acidic or basic [1-3]. Redox Reaction A way to recognize a redox reaction is to look for a change in the oxidation number of the two elements involved in the reaction. The oxidized element increases its oxidation number, while the reduced element decreases its oxidation number. By checking this change, one can quickly determine and tell whether the reaction is redox or not. In a redox reaction, electrons move from one atom to another, which changes the oxidation number or state of the two atoms. The oxidation state of an element corresponds to the number of electrons an atom loses, gains, or appears to use when combining with other atoms in compounds. A half-reaction is part of an overall reaction that separately represents either an oxidation or a reduction. Two half-reactions, including one oxidation and one reduction, must describe a redox reaction completely [4]. Example When a nickel (Ni) strip is placed in an aqueous solution of copper (II) sulfate (CuSO4), an immediate reaction occurs. Copper metal begins to deposit on the strip. The only source of metallic copper in this system is the copper (II) ions (Cu2+) in the solution. The reaction is represented as follows. Cu2+ (aq.) + 2e Cu(0) (s) Here, the Cu2+ ion gains two electrons and is reduced to Cu (0). So, the above equation represents the reduction part of a redox reaction, and hence, it is called a redox half-reaction. On the other hand, nickel releases two electrons to form nickel (II) ions (Ni2+). These are the two electrons that go to copper. Ni(0} (s) Ni2+ (aq.) + 2e Thus, nickel is oxidized, and the above half-reaction represents the oxidation part of the redox reaction. The half-reaction can be used to balance the redox reaction. Consider an example of the combustion redox reaction between magnesium (Mg) and oxygen (O2), resulting in magnesium oxide (MgO). The unbalanced equation is given by: Mg (s) + O2 (g) MgO (s) Mg loses two electrons and becomes an Mg2+ cation. Its oxidation number goes from zero to +2. Hence, it is oxidized. The oxidation part of the reaction is written as: Mg (s) Mg2+ + 2 e On the other hand, O gains two electrons from Mg and becomes O2-, thereby changing its oxidation number from zero to -2. Hence, oxygen is reduced, and the reduction part of the reaction is: O2 (g) + 2 e O2- Adding the two equations together: Mg (s) + O2 (g) MgO (s) Multiplying both sides by 2: 2 Mg (s) + O2 (g) 2 MgO (s) This balanced equation represents the reaction between magnesium and oxygen. Below are some examples of the redox reaction with explanations [1-9]. Redox Reaction Examples 1. The reaction between lead oxide (PbO) and ammonia (NH3) results in nitrogen (N2), water (H2O), and lead (Pb). 3 PbO (s) + 2 NH3 (g) N2 (g) + 3 H2O (l) + 3 Pb (s) The oxidation number of lead decreases from +2 to 0, and Pb is reduced. The oxidation number of nitrogen increases from -3 to zero, meaning N is oxidized. 2. The reaction between carbon (C) and Iron (III) oxide (Fe2O3) results in iron (Fe) and carbon dioxide (CO2). 3 C (s) + 2 Fe2O3 (s) 4 Fe (s) + 3 CO2 (g) The oxidation number of carbon goes from zero to +4, and C is oxidized. The oxidation number of iron decreases from +3 to zero, and Fe is reduced. 3. In a thermite reaction, iron (Fe) atoms in ferric oxide (Fe2O3) lose oxygen (O) atoms to aluminum (Al) atoms, producing aluminum oxide (Al2O3). Fe2O3 (s) + 2 Al (s) Al2O3 (s) + 2 Fe (l) The oxidation number of aluminum goes from zero to +3 (oxidation), and that of iron decreases from +3 to zero (reduction). 4. Chromium (Cr) reacts with hydrochloric acid (HCl) to give chromium chloride (CrCl2) and hydrogen (H2) gas. Cr (s) + 2 HCl (aq.) CrCl2 (aq.) + H2 (g) The oxidation number of chromium increases from zero to +2 (oxidation), and that of hydrogen decreases from +1 to zero (reduction). 5. Sulfur dioxide (SO2) reacts with carbon monoxide (CO) to form sulfur (S) and carbon dioxide (CO2). SO2 (g) + 2 CO (g) S (g) + 2 CO2 (s) The oxidation number of sulfur decreases from +4 to zero (reduction), and that of carbon increases from +2 to +4 (oxidation). 6. In the reaction between manganese (IV) oxide (MnO2) and hydrochloric acid (HCl), the products are manganese (II) chloride (MnCl2), chlorine (Cl2) gas, and water (H2O). MnO2 (s) + 4 HCl (aq.) MnCl2 (aq.) + Cl2 (g) + 2 H2O (l) The oxidation number of manganese decreases from +4 to +2 (reduction), and that of chlorine increases from -1 to zero (oxidation). The following list represents the four types of redox reactions. Redox reactions have many applications in industry and daily life, with many benefits and effects [10]. Conversion of food and oxygen to carbon dioxide and water (cellular respiration, including glycolysis) C6H12O6 + 6 O2 6 CO2 + 6 H2O + Energy Functioning of batteries in all electronic devicesPhotosynthesis reduction of carbon dioxide into sugars and the oxidation of water into molecular oxygen 6 CO2 + 6 H2O + light energy C6H12O6 + 6 O2 Burning of organic material and combustion of hydrocarbons in fossil fuelsExtraction of ores from mineralsElectroplatingDeveloping a photographic filmBleaching and decolorizationCorrosionBreathalyzer Q.1. What is a spontaneous redox reaction? Ans. If a positive voltage is formed across the electrodes in a voltaic cell, the redox reaction is a spontaneous reaction for reduction at the cathode and oxidation at the anode. Q.2. What is the purpose of redox reactions in a living cell? Ans. Redox reactions are important because they are the principal sources of energy for a living cell. Oxidation of molecules by removal of hydrogen or combination with oxygen liberates typically large quantities of energy. Q.3. How do you know if a redox reaction is acidic or basic? Ans. It is an acidic medium if H+ is present while balancing the reaction. If OH is present, then it is a basic medium. Q.4. What makes balancing redox reactions different from balancing other reactions? Ans. Balancing redox reactions is different from balancing other reactions. A half-reaction is used in a redox reaction where the number of atoms and the amount of charge must be balanced. Q.5. Is corrosion a redox reaction? Ans. Yes, corrosion is a redox reaction.

How to recognise oxidation and reduction. How do you know if it's an oxidation reduction reaction. How to tell if its a redox reaction. How to know if its reduction or oxidation. How to know if it's an oxidation reduction reaction. Hoe weet je of iets een reductor of oxidator is.